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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/902,727	07/12/2001	Arpan P. Mahorowala	YOR92000064US1	9512

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EXAMINER
NOVACEK, CHRISTY L

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 03/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/902,727	MAHOROWALA ET AL.	
	Examiner	Art Unit	
	Christy L. Novacek	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 July 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 October 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This Office Action is in response to the communication filed July 12, 2001.

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

Claims 6 and 18 recite the limitation of the plasma comprising an element selected from the group consisting of "hydrogen, fluorine, and chlorine." The specification does not provide support for these limitations.

Claim 7 recites the limitation of "a tuned polymer comprising carbon, hydrogen, and oxygen." However, the specification never specifically discloses that the polymer comprises these elements.

Claim 11 recites the limitation of forming the photoresist by polymerizing various monomers. However, the monomers recited in claim 11 are not disclosed in the specification.

Claims 14 and 15 recite the limitation of the UV radiation comprising "substantially monochromatic radiation". However, the specification does not disclose "monochromatic radiation".

Claim 17 recites the limitation of the photoresist comprising a "stable" material. This limitation is not supported by the specification.

Claim 19 recites the limitation of the "tuned polymer" comprising a polymer selected from the group consisting of "epoxies, and diamond-like carbon". This limitation is not supported by the specification.

Claim 21 recites the limitation of the reactive species comprising "neutrals" and ions. The specification does not disclose that the reactive species comprises "neutrals".

Appropriate correction is required.

Claim Objections

Claims 1, 5, 9-11 and 17 are objected to because of the following informalities:

Claims 1 and 9 refer to "a PR layer", while claims 5, 10, 11 and 17 refer to a "photoresist layer". For the sake of clarity, the claims should consistently refer to the photoresist layer as either "a PR layer" or a "photoresist" layer instead of using both terms. Appropriate correction is required.

Claim 1 (line 12) recites the limitation of "the reactive species". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 6, 7, 11, 14, 15, 17-19 and 21 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 6 and 18 recite the limitation of the plasma comprising an element selected from the group consisting of "hydrogen, fluorine, and chlorine." The specification does not provide support for these limitations.

Claim 7 recites the limitation of "a tuned polymer comprising carbon, hydrogen, and oxygen." However, the specification never specifically discloses that the polymer comprises these elements.

Claim 11 recites the limitation of forming the photoresist by polymerizing various monomers. However, the monomers recited in claim 11 are not disclosed in the specification.

Claims 14 and 15 recite the limitation of the UV radiation comprising "substantially monochromatic radiation". However, the specification does not disclose "monochromatic radiation".

Claim 17 recites the limitation of the photoresist comprising a "stable" material. This limitation is not supported by the specification.

Claim 19 recites the limitation of the "tuned polymer" comprising a polymer selected from the group consisting of "epoxies, and diamond-like carbon". This limitation is not supported by the specification.

Claim 21 recites the limitation of the reactive species comprising "neutrals" and ions. The specification does not disclose that the reactive species comprises "neutrals".

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-27 and 30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation of "providing a semiconductor substrate optionally having at least a hardmask defined thereon; providing an underlayer on said hardmask...". The metes and bounds of this claim cannot be determined because the claim first recites that the substrate "optionally" has a hardmask but then goes on to recite that "an underlayer" is provided "on said hardmask". If the substrate does not contain a hardmask, it is unclear as to whether the underlayer is formed on the substrate or where the underlayer is formed.

Claims 3, 7 and 19 recite the limitation of a "tuned polymer". The specification does not disclose what is meant by a "tuned polymer" and thus, the meaning of this limitation cannot be determined.

Claims 14 and 15 recite the limitation of "said ultraviolet radiation". There is no antecedent basis for this limitation in the claim. Claim 1, upon which claims 14 and 15 depend, recites only "radiation", not "ultraviolet radiation".

Claim 19 recites the limitation of "said tuned polymer". There is no antecedent basis for this limitation in the claim.

Claim 26 recites the limitation of "said process parameters". There is no antecedent basis for this limitation in the claim.

Claim 27 recites the limitation of "The reduced critical dimension bilayer resist image". There is no antecedent basis for this limitation in the claim.

Claim 30 recites the limitation of "The semiconductor device". There is no antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4-6, 8, 12, 13, 17, 18, 20 and 22-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pike et al. (US 6,420,097) in view of the admitted prior art.

Regarding claims 1, 20 and 30, Pike discloses producing a lithographically printed image having a reduced critical dimension. This method involves providing a semiconductor substrate (114), providing an underlayer (126) on the substrate wherein the underlayer is free of any element that forms a non-volatile oxide (comprises a BARC of a water soluble fluoropolymer), and providing a photoresist (PR) layer (122) on the underlayer (Fig. 4a-4d; col. 3, ln. 61-col. 4, ln. 42). The PR is exposed to radiation to form an image therein. This image is transferred into the underlayer. A controlled overetch of the underlayer is performed in order to laterally thin the underlayer. The PR layer is formed such that it comprises a material that is etch-resistant in the step of etching the underlayer. Specifically, Pike states that the PR may be silyated (silicon added thereto) in order to improve its etch selectivity to the underlayer (col. 4, ln. 47-48). Pike discloses that an anisotropic etch may be used to etch the underlayer but does not describe a particular type of etching that is to be used (col. 5, ln. 1-3). The admitted prior art states that a

reactive ion etch (an anisotropic etching process) using oxygen plasma is "well known in the art" (pg. 9, ln. 8-9). At the time of the invention, it would have been obvious to one of ordinary skill in the art to etch the underlayer using an oxygen reactive ion etching process because Pike discloses using an anisotropic process and, in the absence of the disclosure of any particular process, one of ordinary skill in the art would look to use a conventional process such as the oxygen reactive ion etching process disclosed in the admitted prior art.

Regarding claims 2 and 4, Pike discloses that the underlayer may be made of a fluoropolymer (no silicon, boron, phosphorus, germanium or aluminum) (col. 4, ln. 8-11).

Regarding claims 5 and 17, as stated above in reference to claim 1, Pike discloses that the PR may be silyated (silicon added thereto) to improve its etch selectivity to the underlayer (col. 4, ln. 46-48).

Regarding claims 6 and 18, as stated above in reference to claim 1, the admitted prior art discloses that an oxygen reactive ion etching process is conventional in the art.

Regarding claim 8, Pike discloses that the underlayer may comprise an antireflective coating (BARC) (col. 4, ln. 7-11).

Regarding claims 12 and 13, Pike discloses that the radiation used to image the PR layer can be 248-193 nm ultraviolet radiation (UV) (col. 1, ln. 20-28; col. 4, ln. 16-18).

Regarding claims 22-26, Pike discloses overetching the underlayer such that it becomes approximately the width of the desired gate or structure linewidth (col. 4, ln. 23-27). However, Pike does not disclose how the overetching is controlled. The admitted prior art discloses that it is well known in the art to control the etch process by using dilution of the oxygen plasma with non-reactive gases such as nitrogen, and also by controlling various process parameters which

include RF power, operating pressure, gas flowrate, backside He pressure and electrode and wall temperatures (col. 9, ln. 21-26). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the methods disclosed by the admitted prior art to control the etch rate of Pike's etching process because Pike discloses controlling the etch process but does not disclose a specific method of doing so, and the admitted prior art discloses that controlling various process parameters is conventional in the art.

Regarding claim 27, Pike discloses a semiconductor substrate, an organic layer (BARC of fluoropolymer) provided on the substrate, and a photoresist layer provided on the organic layer, wherein the photoresist layer has a first image developed therein, and wherein the organic layer has a second image, of reduced critical dimension and congruent with the first image, developed therein.

Regarding claims 28 and 29, Pike discloses providing a substrate, forming a reduced critical dimension bilayer resist image on the substrate, transferring the image into the substrate forming a circuit image, and forming circuit element materials in said circuit image. Pike discloses that the circuit image may be a gate conductive layer or device layer (col. 3, ln. 64-65; col. 4, ln. 23-29).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Shield et al. (US 20020160320) discloses a process of using a bilayer photoresist to form sublithographic features in an integrated circuit.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (703) 308-5840. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

CLN
March 24, 2003

AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800